ALPINE FLORA OF CERRO QUIEXOBRA, OAXACA, MEXICO

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ABSTRACT

An annotated, vouchered checklist for a timberline plant community at the summit of Cerro Quiexobra in the Sierra Madre del Sur of Oaxaca, Mexico, is presented. Although timberlines at the summit of Cerro Quiexobra are highly irregular and sometimes poorly defined, treeless plant communities in glades and among sporadic rocky substrates from 3400–3700 m exhibit all the hallmark features of an alpine refugium: plants shade-intolerant, short-statured, and exhibiting cespitose growth habits. Cerro Quiexobra's alpine flora includes 80 known species from 28 families and 62 genera, of which 19 species are recognized as narrow endemics on the mountain's upper ridges. This observation identifies the peak as one of the richer centers of rare and endangered plant species in Mexico. Before the advent of recent and widespread fires, this plant community occupied no more than a square kilometer. However, the flora likely extended approximately 170 km across the Sierra Madre del Sur during glacial maxima, while maintaining considerable distance from alpine centers to the north (Pico de Orizaba, Veracruz) and east (Volcán Tacaná, Chiapas). Persistent isolation during the Pleistocene apparently accounts for the high rates of species endemism.

RESUMEN

Se presenta un listado florístico de una comunidad vegetal por encima del límite el bosque en la cumbre del Cerro Quiexobra, Sierra Madre del Sur, Oaxaca, México. Pese a que los límites arbóreos en la ceja del cerro son muy irregulares y a veces mal definidos, las comunidades de plantas en los claros y esporádicamente en los sustratos rocosos de 3500 a 3700 m exhiben características típicas de comunidades alpinas: plantas sin tolerancia a la sombra, de baja estatura y cespitosas. La flora alpina del Cerro Quiexobra incluye 80 especies, 28 familias y 62 géneros, de las cuales 19 especies son reconocidas como endémicas restringidas a esta montaña. Esta observación identifica esta cumbre del cerro como uno de los centros más ricos de especies de plantas raras y amenazadas en México. Previo a los recientes y extensos incendios, esta comunidad vegetal ocupaba no más de un kilómetro cuadrado. No obstante, la flora probablemente se extendía 170 km a través de la Sierra Madre del Sur durante el máximo glacial, manteniendo una distancia considerable de los centros alpinos del norte (Pico de Orizaba, Veracruz) y del este (Volcán Tacaná, Chiapas). El aislamiento persistente durante el pleistoceno explica, aparentemente, las altas tasas de endemismo.

INTRODUCTION

Alpine and subalpine vegetation is often difficult to delimit on summits or along ridges of mountains that approach timberline thresholds. Geophysical discontinuities in the angle and orientation of slopes, varying degrees of exposure to wind and solar irradiation, sporadic fires and local edaphic heterogeneity create and affect discontinuities in the distribution of timberline species and their plant communities (Billings 1974; McDonald 1993). Such is the case for alpine plant communities on the poorly explored summit of Cerro Queixobra (16°12'34"N; 96°11'51"W) in the Sierra Madre del Sur of southern Oaxaca (Fig. 1), where a species-rich association of shade-intolerant species occurs exclusively on the mountain's summit (ca. 3700 m).

The first comprehensive collections of Cerro Quiexobra were accomplished by the author in December of 1989 (*J.A. McDonald 2900-2951*) and October of 1990 (*J.A. McDonald 2987-3040*), followed by significant expeditions by Jaime Hinton and collaborators during October of 1995 (*J. Hinton et al. 26133-26217*) and August of 1996 (*J. Hinton et al. 26641-26843*). These collectors encountered a rich herbaceous flora in moist glades of mountain saddles (*Alepidocline macdonaldana*, *Erigeron quiexobrensis*, *Hieracium abscissum*, *Luzula denticulata*, *Ottoa oenanthoides*, *Schiedeella hyemalis*) and an array of herbs and short-statured (≤1.0 m), lignescent phanerophytes on exposed rock and cliff faces (*Ageratina pichinchensis*, *Aphanactis macdonaldii*, *Castilleja nivibractea*, *Chionolaena macdonaldii*, *Verbesina macdonaldii*, *Valeriana pulchella*). Several miniature, hemi-cryptophytes and chamaephytes (*Calandrinia micrantha*, *Lobelia macdonaldii*, *Oxalis hintoniorum*, *Sisyrinchium tenuifolium*,

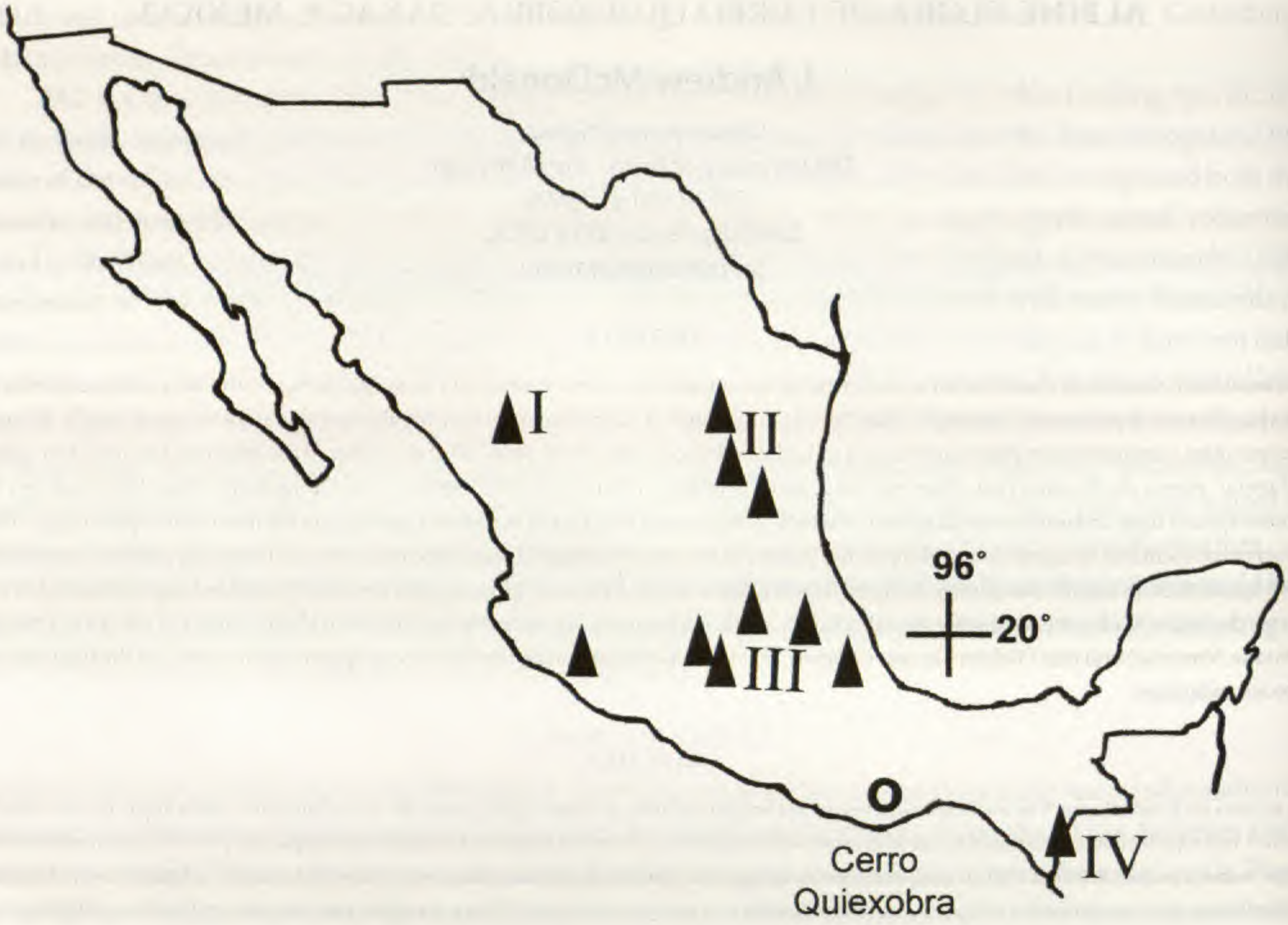

Fig. 1. Modern disjunct distribution of timberline floras in the Sierra Madre Occidental (Zone I), Sierra Madre Oriental (Zone II), central volcanic belt (Zone III), and the Volcán Tacaná (Zone IV). An isolated, relictual, and hitherto unreported alpine plant community occurs in southern Oaxaca – Cerro Quiexobra of the Sierra Madre del Sur (denoted by open circle).

Tauschia filiformis) are locally abundant and often intermingle with creeping, rhizomatous herbs, such as *Oenothera epilobiifolia*, *Potentilla macdonaldii* and a geophytic *Peperomia* (*P. monticola*). Most of the aforementioned genera occur frequently in disjunct alpine zones throughout Mexico. The timberline vegetation of Cerro Quiexobra also harbors unique and highly specialized shrubs and short trees, such as the only known arborescent bluebonnet, *Lupinus jaimehintoniana*, which occupies a shrub-dominated, subalpine ecotone between surrounding pinelands (*P.* aff. *hartwegii*) and treeless zones.

The alpine flora of Cerro Quiexobra is extraordinarily unique in various regards, owing ostensibly to its geographic isolation during the present age and glacial maxima of the Pleistocene (McDonald 1993). Comparing closely in species richness to other alpine refugia of similar size in northeast and northwest Mexico (McDonald 1990, 2011), this highly restricted plant community comprises at least 80 species of herbs and short shrubs. The vegetation is particularly noteworthy in terms of rare and endemic elements, supporting at least 19 species that are presently known exclusively from this high point of the Sierra Madre del Sur, more than double the number of single-peak endemics encountered in other alpine refugia of Mexico (Almeida-Lenero et al. 2007; Beaman 1962, 1966; Laur & Klaus 1975; McDonald 1993, 2011; Narave 1985). Unlike the closest known alpine grasslands to the north and east, Pico de Orizaba of Veracruz and Volcán Tacaná of Chiapas (respectively), as well as alpine grasslands across central Mexico's volcanic belt (19° Lat. N; Almeida-Lenero et al. 1994, 2004, 2007; Gimenez de Azcarate & Escamilla 1995; Rzedowski 1975), an array of forbs and perennial herbs of Cerro Quiexobra, mostly Asteraceae, are dominant over few grasses (5 spp.), caryophylls (2 spp.) and mustards (2 spp.). Asteraceae are especially well represented in terms of species richness (27spp.) and plant cover, and account for a substantial number of narrow endemics (11 spp.). The Apiaceae and Orobanchaceae rank second

in terms of species richness (4 spp. each), followed by the Ericaceae, Plantaginaceae, and Solanaceae, each with three species. As presently known, only two non-native species occur among the natives, *Poa annua* and *Sisymbrium* cf. *irio*, underscoring again the persistent insularity of this plant community.

The remarkable rates of narrow endemism at the summit of Cerro Quiexobra are apparently the result of long-term isolation during both glacial and interglacial periods of the Pleistocene, as well as the distinctive geological substrates of the Sierra Madre del Sur. The closest, aforementioned alpine zones to the north and east of Oaxaca occupy loose basaltic soils and gravel, while Cerro Quiexobra's flora inhabits solid, rocky substrates of a mountain range that is formed by a complex mixture of Lower Cretaceous marine sediments, Proterozoic metamorphic rock and extrusive Tertiary sedimentary volcanics (Ortega-Gutierrez 1992). With respect to evidence that timberline plant communities of Mexico descend around 1000 m during glacial maxima, the alpine vegetation of Cerro Quiexobra presumably expands in distribution during pluvials to cover around 170 km of the east-west backbone of the Sierra Madre del Sur (McDonald 1993). The geographical limits of this relatively broad distribution are still far-removed, however, from insular alpine zones to the north (Pico de Orizaba, Veracruz) by at least 200 km and to the east (Volcán Tacaná, Chiapas) by around 400 km (Fig. 1).

This epicenter of rare and potentially endangered species warrants serious attention in terms of research and protection. While timber extractions and the establishment of logging roads during the last two decades have altered surrounding pine woodlands considerably, as have widespread, recurrent and devastating fires (fide J. Hinton; Turner 1995), the short- and long-term impacts of these disturbances are essentially unknown. Given the fragility of slow-growing alpine vegetation and the significant degradation these plant communities in recent years on account of over-grazing, fires, trail erosion, and human recreation (Gimenez de Azcarate & Escamilla 1999; Almeida-Lenero et al. 2007), successful efforts to protect this biologically diverse refugium would conserve valuable evidence to better elucidate Mexico's deep and colorful, natural history.

ANNOTATED CHECKLIST OF VASCULAR PLANT TAXA

Specimens of J. Andrew McDonald (**JAM**) and Jaime Hinton (**JH**) are located at TEX, with duplicates of most of these at MEXU. Species that are known to be narrow endemics are denoted with an asterisk.

PTERIDOPHYTA

Aspleniaceae

Asplenium castaneum Schlecht. & Cham. (*JAM 3020; JH 26142*)

CONIFEROPHYTA

Pinaceae

Pinus aff. *hartwegii* Lindl. (*JAM 2945, 3031; JH 26158*)
Pinus sp. (sterile, *JAM 2945*)

MAGNOLIPHYTA

Apiaceae

Neogoezia minor Hemsl. (*JAM 2998, 3026; JH 26643*)
Ottoa oenanthoides Kunth (*JH 26217*)
Tauschia filiformis J.M. Coult. & Rose (*JAM 2999; JH 26542, 26796*)

Asteraceae

**Ageratina macdonaldii* B.L. Turner (*JAM 2916, 3006; JM 26139, 26515*)
Ageratina pichinchensis (Kunth) R.M. King & H. Rob. (*JAM 2913, 3052, 3011*)
**Alepidocline macdonaldana* B.L. Turner (JAM 3009)
**Aphanactis macdonaldii* B.L. Turner (JAM 2904, 3007; JH 26138, 26138, 26148, 26792)
**Archibaccharis macdonaldii* G.L. Nesom (JAM 2932; JH 26143)
Baccharis multiflora Kunth (*JAM 2933, 3039*)
Bidens triplinervia Kunth (*JAM 2926, 2931, 3010; JH 26155*)
**Chionolaena macdonaldii* (G.L. Nesom) G.L. Nesom (JAM 2943, 3036)
Cirsium oaxacanum G.L. Nesom (*JAM 2910; JH 26153*)
Dahlia aff. *coccinea* Cav. (*JAM 3022*)
**Erigeron quiexobrensis* G.L. Nesom (*JAM 3005; JH 26212, 26793*)
Hieracium abscissum Less. (*JAM 2912, 3034, 2912*)
**Hieracium macdonaldii* Beaman & B.L. Turner (*JAM 2950, 3037*)
Laennecia gnaphalioides (Kunth) Cass. (*JAM 2950.5*)
Osbertia stolonifera (DC.) Greene (*JAM 3008; JH 26798*)
Psacalium peltatum Cass. var. *peltatum* (*JAM 2949, 3038; JH 26156*)
**Psacaliopsis macdonaldii* (B.L. Turner) C. Jeffrey (*JAM 2992; JH 26794*)
Pseudognaphalium liebmannii (Sch.Bip. ex Klatt) Anderb. (*JAM 2934*)
Roldana hartwegii (Benth.) H. Rob. var. *subcymosa* (H. Rob.) Funston (*JH 26154*)
Roldana lineolata (DC.) H. Rob. & Brettell (*JH 26157*)
Roldana petasitis (Sims.) H. Rob. var. *oaxacana* (Hemsl.) Funston (*JAM 2951*)
Senecio callosus Sch. Bip. (*JAM 2911; JH 26211*)
**Senecio warszewiczii* A. Braun & Bouché (*JAM 2930*)
Stevia incognita Grashoff (*JAM 2946*)
Stevia lucida Lag. var. *oaxacana* (DC.) Grashoff (*JAM 2935*)
**Stevia quiexobra* B.L. Turner (3040; *JH 26141*)
**Verbesina macdonaldii* B.L. Turner (*JAM 2936*)

Boraginaceae

**Nama quiexobranum* Bacon & McDonald (*JAM 2914, 3014; JH 26147*)

Brassicaceae

Lepidium schaffneri Thell. (*JH 26788*)
Sisymbrium aff. *irio* L. (*JAM 3012*)

Campanulaceae

**Lobelia macdonaldii* B.L. Turner (*JAM 2996; JH 26146, 26151, 26786*)

Caryophyllaceae
Arenaria lanuginosa (Michx.) Rohrb. var. *lanuginosa* (*JAM 2908, JH 26215, 26802*)
Cerastium guatemalense Standl. (*JAM 2906*)

Crassulaceae
Echeveria sp. (*JAM 2944*)
Sedum mesoamericanum P. Carrillo-Reyesa & M.A. Pérez-Farrerab (*JAM 2942*);

Ericaceae
Arbutus xalapensis Kunth (*JAM 2939*)
Arctostaphylos pungens Kunth. (*JAM 2941*)
Pernettya prostrata (Cav.) DC. (*JAM 2922; JH 26149*)

Fabaceae
**Lupinus jaimehintoniana* B.L. Turner (JAM 2921; JH 26160)
Lupinus aff. *montanus* Kunth (*JAM 2923, 2921*)

Geraniaceae
Geranium seemannii Peyr. (*JAM 2907, 2990*)

Iridaceae
Sisyrinchium johnstonii Standl. (*JH 26795*)
Sisyrinchium tenuifolium Humb. & Bonp. ex Willd. (*JAM 3015; JH 26161*)

Juncaceae
Luzula denticulata Liebm. (*JAM 3027*)

Lamiaceae
Salvia stolonifera Benth. (*JAM 3004; JH 26159, 26787*)
Stachys coccinea Ortega (*JAM 2927*)

Montiaceae
Calandrinia micrantha Schltdl. (*JAM 2933*)
Claytonia perfoliata Donn ex Willd. (*JAM 2905, 2997*)

Onagraceae
Lopezia racemosa Cav. (*JAM 2918*)
Oenothera epilobiifolia Kunth (*JAM 2994; JH 26165*)

Orchidaceae
Schiedeella hyemalis (A. Rich. & Gal.) Burns-Bal. (*JAM 2915; JH 26140, 26209*)

Orobanchaceae
Castilleja integrifolia L.f. (*JAM 2937*)
**Castilleja nivibractea* G.L. Nesom (*JAM 2948, 3002*)
**Castilleja quiexobrensis* G.L. Nesom (*JAM 2928*)
**Castilleja zempoaltepetlensis* G.L. Nesom (*JH 26133, 26451, 26800*)

Oxalidaceae
**Oxalis hintoniorum* B.L. Turner, in prep (*JAM 3017; JH 26799*)

Piperaceae
Peperomia monticola Miq. (*JAM 3019*)

Plantaginaceae
Penstemon campanulatus (Cav.) Willd. (*JAM 2929*)
Penstemon gentianoides (Kunth) Poir. (*JAM 2925; JH 26134, 26801*)
Penstemon kunthii G. Don (*JAM 2929, 3025; JH 26299*)

Poaceae
Agrostis ghiesbreghtii E. Fourn. (*JAM 2938 3031*)
Koeleria pyramidata (Lam.) P. Beauv. (*JAM 2947*)
Poa annua L. (*JAM 2917*)
Trisetum cf. *pringlei* (Scribn. ex Beal) Hitch. (*JAM 2920*)
Vulpia myuros (L.) C.C. Gmel. var. *myros* (*JAM 2903, 3030*)

Ranunculaceae
Ranunculus petiolaris HBK (*JAM 2991*)

Rosaceae
Acaena elongata L. (*JAM 2940; JH 26216*)
**Potentilla macdonaldii* B.L. Turner (*JAM 2919*)

Solanaceae
Solanum demissum Lindl. (*JAM 2987*)
Solanum pseudocapsicum L. (*JH 26797, 26806*)
Solanum schenckii Bitter (*JAM 3016*)

Urticaceae
Urtica urens L. (*JAM 3003*)

Valerianaceae
Valeriana pulchella M. Martens & Galeotti (*JAM 3022*)

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